Productivity in industry and government, 1989

Fewer industries showed increases in output per employee hour in 1989, compared with the previous year, however, more than half of all the industries measured recorded higher productivity growth during 1984–89 than during the pre-1984 period

Richard B. Carnes

Productivity, as measured by output per employee hour, increased in 1989 in about 60 percent of the industries for which data are currently available. By comparison, in 1988, more than 75 percent of these same industries posted gains in productivity. In 1989, most industries that experienced productivity increases also showed gains in output. Similarly, for those industries with negative or no productivity growth, most showed declines in output.

This article includes indexes from the Bureau of Labor Statistics industry and government productivity measurement program and extends labor productivity measures through the year 1989; industry multifactor productivity measures through 1988; and the Federal, State, and local government measures through fiscal year 1989.[1] Table 1 shows labor productivity average annual percent changes for the long term (beginning year to 1989) and for 1984–89, and percent changes for 1987–88 and 1988–89 for all of the industry productivity measures. It includes, for the first time, labor productivity measures for frozen fruits and vegetables, rubber and plastic hose and belting, and a multifactor productivity measure for the farm and garden equipment industry.[2] Indexes for most of the industry labor productivity measures for selected years between 1970 and 1989 are shown in table 47 of the Current Labor Statistics section of this publication.

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Industry labor productivity

Manufacturing. Two important industries, steel and autos, recorded productivity declines in 1989. The productivity drop of 2.3 percent for the steel industry, reflecting a 5-percent increase in unused capacity, was the first since 1982. Likewise, the 0.4-percent decrease in productivity for motor vehicles and equipment came after nearly a decade of annual gains. Both industries were affected by output declines. Output fell 3.5 percent in the steel industry, as demand diminished from the machinery, automotive, and construction sectors, while the 0.8-percent output decrease in the motor vehicles and equipment industry was largely the result of a decline in the number of passenger cars produced.

Several other manufacturing industries exhibited sharp declines in productivity. Declines of more than 5 percent were recorded for copper rolling and drawing, lawn and garden equipment, and ball and roller bearings. Output also fell in these industries.

By contrast, many manufacturing industries recorded significant gains in productivity in 1989: metal cutting machine tools, 25.8 percent; semiconductors and related devices, 16.2 percent; farm machinery, 10.2 percent; and oilfield machinery, 9.4 percent. Technological improvements in the metal cutting machine tools industry, such as the use of carbide tooling and improved designs in rotary tables and cutting inserts, were factors in the productivity increase. Output exerted a strong influence, advancing by 30.5 percent, the result of increased exports and new orders in the prior year. Output in the three other industries was similarly driven by strong demand as orders from both 1988 and 1989 were filled.

Mining. Although all of the industries measured in the mining sector showed productivity and output increases in 1988, productivity de-

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clined in 1989—with the exception of coal. Productivity growth in that industry registered 4.6 percent in 1989, reflecting a 3.1–percent gain in output, as utilities relied on coal to meet increased consumer demand, and companies developed new equipment and expanded longwall mining techniques. Productivity fell in the iron mining (1.4 percent), copper mining (1.9 percent), and nonmetallic minerals industries (1.2 percent), but for varying reasons. Productivity in iron mining was hampered by the renovation of idle mines, while productivity and output in the nonmetallic minerals industry declined as a result of slowdowns in the construction sector. Producers in the copper mining industry, encouraged by record demand and prices for copper, opened older, less ore-rich mines, expending labor time on less productive operations to increase total output.

Transportation, communications, and utilities. In 1989, 4 of the 7 industries within the transportation, communications, and utilities sector recorded productivity increases. Productivity grew 6.4 percent in railroad transportation (revenue traffic), 6.0 percent in telephone communications, 4.0 percent in intercity trucking, and 2.6 percent in electric utilities. Underlying this productivity growth were increases in output for all of these four industries.

Industries in the transportation, communications, and utilities sector showing productivity declines included: petroleum pipelines (–6.8 percent), air transportation (–3.5 percent), and gas utilities (–1.3 percent). This was only the second productivity decline in the petroleum pipeline industry since 1982, reflecting an output decline of 6.2 percent, mainly in the transport of crude petroleum. Air transportation showed an output increase of 3.3 percent, but recorded an even higher employment increase of 7.1 percent, as additional personnel were hired in response to concerns about safety, security, and growth in passenger projections.

Trade. Productivity increased in only 6 of the 18 industries in the trade sector for which the Bureau has current data. In comparison, 11 of these industries recorded productivity increases in 1988. Productivity in variety stores grew 7.8 percent, resulting from a 3.0-percent decline in output and a 10.1-percent decline in hours. Industry consolidation in the face of declining output continued, as strong competitive pressure forced weak firms out of the industry. The remaining firms became increasingly sophisticated, using computers to track inventories and improving stock selection of items with high sales volumes to entice more purchases. Similar trends underlie liquor store productivity which increased by 3.2 percent, while output declined by 1.8 percent and hours declined 4.8 percent.

Moderate productivity increases were registered in family clothing stores (2.0 percent) and shoe stores (1.5 percent), the latter continuing to benefit from strong demand for athletic footwear. Productivity advanced 0.4 percent in the appliance, radio, television, and music stores industry. While productivity and output gains in the radio, television, and music store segments were solid, generated by interest in consumer electronics, they only slightly offset the considerable declines in productivity and output in the appliance segment, adversely affected by the residential construction slowdown.

Productivity in the scrap and waste materials industry declined 9.0 percent in 1989. Output grew 0.7 percent while hours increased 10.7 percent. Some other trade industries with productivity declines include: retail bakeries (–6.4 percent), men's and boys' clothing stores (–4.2 percent), furniture and home furnishings stores (–1.9 percent), department stores (–1.7 percent), eating and drinking places (–1.7 percent), and gasoline service stations (–1.3 percent). Many of these industries were affected by price increases and sluggish consumer spending. Department stores and eating and drinking places in particular were also affected by the opening of additional outlets in many locations.

Service. Reversing the 1988 trend in which a majority of measured service industries showed productivity declines, only hotels, motels, and tourist courts registered a falloff in 1989. The industry's 6.0-percent decline in productivity reflects a decrease in output of 3.1 percent and an increase in hours of 3.0 percent. New rooms continued to be added while occupancy rates and per person expenditures on food and beverages slowed. Increases in productivity were recorded in beauty and barber shops, 5.7 percent, laundry and cleaning services, 2.6 percent, and automotive repair shops, 2.2 percent.

Labor productivity trends

Labor productivity in over 90 percent of the measured industries increased over the long term. Among the industries with the highest growth in labor productivity were semiconductors and wet corn milling. In the semiconductors industry, productivity advanced at a rate of over 12 percent between 1972 and 1989. Burgeoning output, coupled with rapid improvements in product design, and manufacturing techniques, contributed to this spectacular growth. In the wet corn milling industry, productivity advanced at

Table 1. **Productivity trends in selected industries, average annual percent changes, beginning year to 1989 and 1984-89, and percent changes, 1987-88 and 1988-89**

SIC code[1]	Industry	Change, beginning year through 1989		Average annual percent change, 1984–89[2]	Percent change, 1987–88	Percent change, 1988–89
		Beginning year	Average annual percent change			
	Mining					
1011	Iron mining, crude ore	1955	4.4	10.6	7.6	–2.6
1011	Iron mining, usable ore	1955	3.5	9.9	5.0	–1.4
021	Copper mining, crude ore	1955	4.0	7.9	6.4	–1.3
1021	Copper mining, recoverable metal	1955	3.4	6.8	10.0	–1.9
111,121	Coal mining	1955	1.8	7.4	10.9	4.6
121	Bituminous coal and lignite mining	1955	1.8	7.4	11.0	3.9
14	Nonmetallic minerals, except fuels	1958	2.0	2.4	2.3	–1.2
142	Crushed and broken stone	1958	2.6	3.5	1.7	–2.8
	Manufacturing					
2011,13	Red meat products	1967	[3]2.7	[3].7	2.2	—
2011	Meat packing plants	1967	2.9	–.2	.3	–.2
2013	Sausages and other prepared meats	1967	[3]1.9	[3]2.1	5.3	—
2016,17	Poultry dressing and processing	1963	[3]2.9	[3].4	–2.4	—
2026	Fluid milk	1958	4.6	3.7	3.8	.7
203	Preserved fruits and vegetables	1947	[3]2.7	[3]1.3	1.0	—
2033	Canned fruits and vegetables	1958	[3]3.1	[3]4.2	2.3	—
2037	Frozen fruits and vegetables	1972	[3]1.9	[3]1.1	–.2	—
204	Grain mill products	1963	[3]3.7	[3]4.7	.4	—
2041,45	Flour (including flour mixes) and other grains	1963	[3]2.7	[3]3.3	1.9	—
2041	Flour and other grain mill products	1947	3.6	3.4	2.2	–2.4
2043	Cereal breakfast foods	1963	[3]2.1	[3].2	–2.7	—
2044	Rice milling	1963	2.1	7.6	1.4	21.7
2046	Wet corn milling	1963	[3]8.2	[3]4.9	–4.3	—
2047,48	Prepared feeds for animals and fowls	1963	[3]3.5	[3]3.2	3.0	—
2051,52	Bakery products, except frozen	1947	[3]2.0	[3].3	–6.4	—
2061,62,63	Sugar	1947	3.0	4.4	–.8	–4.8
2061,62	Raw and refined cane sugar	1958	2.2	4.5	2.2	–.9
2063	Beet sugar	1958	1.9	4.2	–5.5	–9.9
2082	Malt beverages	1947	5.9	6.1	4.8	–.2
2086	Bottled and canned soft drinks	1958	3.6	7.1	7.1	8.3
2111,21,31	All tobacco products	1947	2.5	6.7	6.2	19.0
2111,31	Cigarettes, chewing and smoking tobacco	1947	1.6	6.4	7.4	11.9
2121	Cigars	1947	4.1	2.0	–1.1	12.4
2211,21	Cotton and synthetic broad woven fabrics	1972	3.5	2.2	.9	1.4
2251,52	Hosiery	1947	5.5	.4	2.2	1.1
2281	Nonwool yarn mills	1958	3.0	8.5	3.7	4.9
2311	Men's and boys' suits and coats	1967	1.8	2.0	2.0	.1
2421	Sawmills and planing mills, general	1958	2.6	2.9	–.5	.4
2431	Millwork	1958	[3].6	[3]1.0	–9.3	—
2434	Wood kitchen cabinets	1972	[3]1.1	[3]3.2	–2.8	—
2435,36	Veneer and plywood	1958	[3]3.6	[3]5.4	1.7	—
2435	Hardwood veneer and plywood	1972	[3]2.6	[3]8.0	4.5	—
2436	Softwood veneer and plywood	1972	[3]3.1	[3]4.2	.5	—
251	Household furniture	1958	2.0	1.3	–.4	.2
2511,17	Wood household furniture	1958	1.7	1.6	–.2	1.1
2512	Upholstered household furniture	1958	2.1	.3	–.3	–1.2
2514	Metal household furniture	1958	2.3	1.4	.0	5.9
2515	Mattresses and bedsprings	1958	3.3	3.4	–5.0	.6
252	Office furniture	1958	1.8	–1.0	–4.5	–.2
2521	Wood office furniture	1958	1.1	–1.6	–5.2	–5.2
2522	Metal office furniture	1958	2.1	–.6	–4.1	2.9
2611,21,31,61	Paper, paperboard, and pulp mills	1947	3.7	3.5	2.9	–.9
2643	Paper and plastic bags	1954	[3]2.2	[3]1.2	.2	—
2651	Folding paperboard boxes	1963	1.5	1.2	.8	1.1
2653	Corrugated and solid fiber boxes	1958	3.5	.8	2.8	–2.0
281	Industrial inorganic chemicals	1972	[3].5	[3]2.2	3.9	—
2812	Alkalies and chlorine	1972	[3]4.4	[3]8.5	1.1	—
2816	Inorganic pigments	1972	[3]1.9	[3]5.1	2.6	—
2819 PT	Industrial inorganic chemicals, not elsewhere classified	1972	[3]–.4	[3].4	2.9	—
2823,24	Synthetic fibers	1957	[3]6.0	[3]7.1	5.2	—

See footnotes at end of table.

Table 1. **Continued—Productivity trends in selected industries**

SIC code[1]	Industry	Change, beginning year through 1989		Average annual percent change, 1984–89[2]	Percent change, 1987–88	Percent change, 1988–89
		Beginning year	Average annual percent change[2]			
2834	Pharmaceutical preparations	1963	3.3	1.3	2.8	–1.7
2841	Soaps and detergents	1958	[3]2.0	[3]3.2	2.4	—
2844	Cosmetics and other toiletries	1958	[3]2.7	[3]4.3	2.2	—
2851	Paints and allied products	1958	2.6	1.2	1.2	–1.3
2869	Industrial organic chemicals, not elsewhere classified	1963	[3]4.0	[3]6.4	9.3	—
287	Agricultural chemicals	1972	[3]2.4	[3]1.4	.6	—
2873	Nitrogenous fertilizers	1972	[3]3.9	[3].7	–1.5	—
2874	Phosphatic fertilizers	1972	[3]2.4	[3]1.4	–7.3	—
2875	Fertilizers, mixing only	1972	[3].6	[3].8	1.6	—
2879	Pesticides and agricultural chemicals, not elsewhere classified	1972	[3]2.4	[3]2.6	7.0	—
2911	Petroleum refining	1947	4.0	5.7	4.8	3.5
3011	Tires and inner tubes	1947	3.6	2.7	–1.3	3.4
3052	Rubber and plastic hose and belting	1972	[3]1.2	[3]1.7	–.1	—
3079	Miscellaneous plastic products	1972	2.4	3.7	–1.0	2.3
314	Footwear	1947	.9	.7	.5	3.3
3221	Glass containers	1947	2.2	3.2	–6.6	1.7
3241	Hydraulic cement	1947	3.4	3.3	1.1	5.8
325	Structural clay products	1958	[3]2.7	[3]2.8	2.5	—
3251,53,59	Clay construction products	1958	2.8	4.1	4.5	8.9
3251	Brick and structural clay tile	1958	1.8	3.3	3.2	4.0
3253	Ceramic wall and floor tile	1958	[3]3.9	[3]2.1	3.0	—
3255	Clay refractories	1958	[3]2.7	[3]2.4	1.1	—
3271,72	Concrete products	1947	[3]2.5	[3]1.4	1.9	—
3273	Ready-mixed concrete	1958	[3].9	[3]4.3	9.8	—
331	Steel	1947	2.1	5.1	10.1	–2.3
3321	Gray iron foundries	1954	1.9	2.4	4.4	4.4
3324,25	Steel foundries	1954	.6	–1.5	–4.2	–.2
3325	Steel foundries, not elsewhere classified	1972	–.1	.4	.6	–.8
3331,32,33	Primary copper, lead, and zinc	1947	3.4	13.4	4.5	–1.6
3331	Primary copper	1947	3.3	16.4	4.1	1.0
3334	Primary aluminum	1947	3.1	2.5	3.6	2.5
3351	Copper rolling and drawing	1958	2.5	.9	.4	–5.5
3353,54,55	Aluminum rolling and drawing	1958	4.1	2.3	.3	.5
3411	Metal cans	1947	2.6	2.7	1.5	7.9
3423	Hand and edge tools	1958	[3].6	[3]1.5	1.8	—
3433	Heating equipment, except electric	1972	[3]2.0	[3]4.2	10.2	—
3441	Fabricated structural metal	1958	[3]1.0	[3]1.5	–1.6	—
3442	Metal doors, sash, and trim	1967	[3]1.0	[3]–.7	–2.9	—
3465,66,69	Metal stampings	1963	[3]1.1	[3]2.4	2.0	—
3465	Automotive stampings	1972	[3]2.3	[3]1.3	3.9	—
3469	Metal stampings, not elsewhere classified	1972	[3].0	[3]3.6	–.7	—
3494	Valves and pipe fittings	1954	[3]1.1	[3]1.8	.1	—
3498	Fabricated pipe and fittings	1958	[3]–.4	[3]–7.5	–2.2	—
3519	Internal combustion engines, not elsewhere classified	1967	[3]1.7	[3]2.8	.7	—
352	Farm and garden machinery	1958	2.0	2.6	1.3	5.3
3523	Farm machinery and equipment	1972	.5	2.1	5.1	10.2
3524	Lawn and garden equipment	1972	2.5	4.0	–5.2	–5.2
3531	Construction machinery and equipment	1958	1.5	2.0	3.4	4.8
3532	Mining machinery	1972	[3]–.3	[3]2.3	–1.3	—
3533	Oilfield machinery and equipment	1967	–.6	1.0	19.0	9.4
3541,42	Machine tools	1958	.6	7.2	6.8	17.1
3541	Metal-cutting machine tools	1958	.9	7.6	2.4	25.8
3542	Metal-forming machine tools	1958	–.1	6.1	16.3	.9
3545	Machine tool accessories	1963	[3].7	[3]1.7	–1.4	—
3561,63	Pumps and compressors	1958	[3]1.8	[3]3.2	1.6	—
3561	Pumps and pumping equipment	1972	[3]1.2	[3]2.9	.5	—
3562	Ball and roller bearings	1958	1.3	1.8	1.5	–5.1
3563	Air and gas compressors	1972	[3]1.3	[3]3.9	5.1	—
585	Refrigeration and heating equipment	1967	[3]1.0	[3].5	1.7	—
3592	Carburetors, pistons, rings and valves	1972	[3].4	[3]2.9	5.0	—
3612	Transformers	1963	[3]1.5	[3]2.3	4.2	—

See footnotes at end of table.

Table 1. **Continued—Productivity trends in selected industries**

SIC code[1]	Industry	Change, beginning year through 1989		Average annual percent change, 1984–89[2]	Percent change, 1987–88	Percent change, 1988–89
		Beginning year	Average annual percent change[2]			
3613	Switchgear and switchboard apparatus	1963	1.9	2.2	4.1	–.8
3621	Motors and generators	1954	2.3	3.0	3.8	2.7
3631,32,33,39	Major household appliances	1958	4.1	4.1	2.5	6.5
3631	Household cooking equipment	1958	4.2	6.6	1.0	6.0
3632	Household refrigerators and freezers	1958	4.4	2.0	2.9	7.8
3633	Household laundry equipment	1958	3.8	4.1	6.6	6.4
3639	Household appliances,not elsewhere classified	1958	3.0	4.0	.6	4.2
3641	Electric lamps	1954	2.2	4.2	1.4	8.1
3645,46,47,48	Lighting fixtures	1961	1.9	1.7	3.0	–2.9
3651	Radio and television receiving sets	1958	6.5	4.2	4.8	8.3
3674	Semiconductors and related devices	1972	12.6	12.4	8.0	16.2
371	Motor vehicles and equipment	1957	3.1	2.9	2.9	–.4
3825	Instruments to measure electricity	1972	[3]3.1	[3]1.3	6.5	—
3861	Photographic equipment and supplies	1967	[3]3.6	[3]2.7	4.4	—
	Services					
4011	Class I Railroad transportation, revenue traffic	1947	4.9	10.3	9.7	6.4
4011	Class I Railroad transportation, car-miles	1947	3.5	7.1	7.1	3.7
4111,413 414 PTS	Bus carriers, class I	1954	[3]–.2	[3]1.8	8.0	—
4213 PT	Intercity trucking	1954	2.7	2.8	5.2	4.0
4213 PT	Intercity trucking (general freight)	1954	2.9	3.4	7.7	.5
4511,4521 PT	Air transportation	1947	5.9	.9	–3.5	–3.5
4612,13	Petroleum pipelines	1958	4.3	.8	8.4	–6.8
4811	Telephone communications	1951	6.0	5.2	5.3	6.0
491,92,93	Gas and electric utilities	1947	4.1	2.0	5.1	1.8
491,493 PT	Electric utilities	1958	3.2	3.2	4.8	2.6
492,493 PT	Gas utilities	1958	.7	–2.3	5.8	–1.3
5093	Scrap and waste materials	1977	2.4	.5	–2.0	–9.0
5251	Hardware stores	1972	1.6	2.8	8.8	–.1
5311	Department stores	1967	3.1	2.0	.8	–1.7
5331	Variety stores	1967	–1.2	–6.4	–1.5	7.8
54	Retail food stores	1958	.5	–1.5	–.5	–3.8
5411	Grocery stores	1972	–.6	–2.2	–1.0	–3.1
546	Retail bakeries	1972	–1.7	1.2	–2.4	–6.4
5511	Franchised new car dealers	1958	1.7	.2	3.7	.0
553	Auto and home supply stores	1972	2.9	3.4	4.4	.5
5541	Gasoline service stations	1958	4.0	2.2	1.1	–1.3
56	Apparel and accessory stores	1967	3.3	.4	1.1	2.0
5611	Men's and boys' clothing stores	1967	2.4	..9	–4.2	
5621	Women's ready-to-wear stores	1967	4.2	–.5	–2.2	–.2
5651	Family clothing stores	1967	3.5	–.7	1.6	2.0
5661	Shoe stores	1967	1.5	2.2	2.4	1.5
57	Furniture, furnishings and equipment stores	1967	3.1	2.4	3.6	–.8
571	Furniture and home furnishings stores	1967	2.0	.3	-.9	-1.9
572,73	Appliance, radio, TV, and music stores	1967	4.9	5.6	10.7	.4
572	Household appliance stores	1972	3.7	.8	–.8	–6.0
573	Radio, television, and music stores	1972	5.7	7.0	14.9	1.5
58	Eating and drinking places	1958	.2	.9	1.7	–1.7
5912	Drug and proprietary stores	1958	3.0	–.7	.8	–1.8
5921	Liquor stores	1972	–.2	–2.3	–2.1	3.2
602	Commercial banking	1967	[3]1.5	[3]3.8	5.0	—
7011	Hotels, motels, and tourist courts	1958	1.4	–2.4	–3.6	–6.0
721	Laundry and cleaning services	1958	.2	–1.3	–1.3	2.6
7231,41	Beauty and barber shops	1972	.5	.6	–2.8	5.7
7231	Beauty shops	1972	.4	–.7	–3.7	6.7
753	Automotive repair shops	1972	–.7	2.7	4.4	2.2

[1] As defined in the *Standard Industrial Classification Manual, 1972*, published by the Office of Management and Budget.

[2] Based on the linear least squares trends of the logarithms of the index numbers.

[3] Ends in 1988.

NOTE: Dash indicates data not available.

Table 2. **Multifactor and related productivity indexes for selected industries, 1984–88 and percent changes, 1984–88**

[1982 = 100]

SIC code	Industry and measure	1984	1985	1986	1987	1988[1]	Average annual percent change, 1984–88[2]	Percent change, 1987–88
3011	Tires and tubes:							
	Multifactor productivity	111.5	110.1	112.6	121.8	123.5	3.1	1.4
	Output per hour	114.7	114.4	117.3	125.8	124.5	2.6	−1.0
	Output per unit of capital	137.8	129.6	125.3	142.2	152.5	3.0	7.2
	Output per unit of intermediate purchases	101.9	101.7	106.0	113.0	113.5	3.3	.4
314	Footwear:							
	Multifactor productivity	97.3	91.1	90.6	93.1	93.9	−.5	.9
	Output per hour	99.1	99.4	101.2	99.5	100.8	.4	1.3
	Output per unit of capital	88.4	78.8	73.2	74.8	76.4	−3.4	2.1
	Output per unit of intermediate purchases	100.0	92.0	92.5	97.3	97.6	.1	.3
331	Steel:							
	Multifactor productivity	123.9	126.5	129.6	144.5	157.5	6.3	9.0
	Output per hour	133.8	141.3	147.8	164.3	192.0	9.1	16.9
	Output per unit of capital	131.6	132.1	133.4	161.4	205.1	11.5	27.1
	Output per unit of intermediate purchases	117.4	118.2	120.1	131.7	131.7	3.4	.0
352	Farm and garden machinery:							
	Multifactor productivity	103.6	99.1	96.6	104.4	110.0	1.7	5.4
	Output per hour	109.6	103.6	104.8	112.9	117.9	2.3	4.4
	Output per unit of capital	106.9	95.9	91.8	106.5	123.9	4.1	16.3
	Output per unit of intermediate purchases	98.4	98.5	95.2	98.9	98.3	.0	− .6
371	Motor vehicles and equipment:							
	Multifactor productivity	111.2	115.7	110.0	110.8	115.2	.3	4.0
	Output per hour	119.9	126.1	126.6	133.8	137.9	3.4	3.1
	Output per unit of capital	182.0	193.9	183.2	184.1	194.9	.9	5.9
	Output per unit of intermediate purchases	98.2	101.4	94.9	94.2	97.8	− .8	3.8

[1] Preliminary.

[2] Based on the linear least squares trends of the logarithms of the index numbers.

a rate of 8.2 percent. Until 1972, output and productivity growth were modest. Thereafter, output and productivity expanded rapidly due in part to the increased market penetration of high fructose and glucose syrup which resulted in rapid modernization of the industry. The radio and television receiving sets industry, at 6.5 percent, and the synthetic fibers industry, at 6.0 percent, were two other manufacturing industries with strong productivity growth in the long run.

There were industries with high rates of long-term productivity growth in the nonmanufacturing sectors of the economy, as well. In the mining sector, both iron and copper mining productivity increased about 3.5 percent annually. Among utilities, productivity in telephone communications grew at a rate of 6.0 percent, while in the transportation sector, air transportation grew 5.9 percent annually. In the trade sector, output per hour of gasoline service stations, women's ready-to-wear stores, and appliance, radio, television, and music stores all advanced at rates of between 4 and 5 percent per annum. For those measured industries in the remaining service related sectors, commercial banking recorded the highest long-term average annual growth in productivity—1.5 percent.

However, several industries did exhibit declining productivity over the long term. Among the most prominent of these was the grocery store industry which recorded a long-term annual decline of 0.6 percent since 1972. Output grew at a rate of 1.4 percent while work force hours increased 1.9 percent per annum. Grocery store productivity has benefited from the increasing number of "warehouse" stores and the use of computerized cash registers and optical scanners. However, these positive factors were more than offset by the growth in labor intensive specialty departments (such as salad bars, delicatessens, and bakeries) and longer store hours. Future productivity should improve as technology, such as optical scanners, becomes more diffused throughout the industry and new innovative procedures such as self-service checkouts are developed.

Other large industries with long-term average annual rates of productivity declines include retail bakeries, –1.7 percent, variety stores, –1.2 percent, auto repair shops, –0.7 percent, and industrial inorganic chemicals, –0.4 percent.

Table 3. **Productivity indexes for the Federal Government, 1984–89, and percent change, 1988–89, 1984–89, and 1967–89**

Function	1984	1985	1986	1987	1988	1989	Percent change 1988–89	Average annual percent change, 1984–89	Average annual percent change, 1967–89
Total measured portion	105.0	102.2	103.8	104.1	104.7	104.3	− .3	.6	1.4
Audit of operations	105.0	107.9	100.4	90.6	91.4	96.2	5.3	−2.9	.4
Buildings and grounds	102.7	101.4	96.4	95.9	92.2	93.8	1.7	−2.1	2.8
Communications	116.7	123.4	128.9	135.0	141.4	136.3	−3.6	3.6	[1]9.5
Education and training	96.7	97.1	97.7	96.5	100.8	100.1	−.7	.8	[2]1.6
Electric power production and distribution	106.9	93.1	86.7	70.4	64.1	88.2	37.5	−6.3	−3.8
Equipment maintenance	104.5	106.0	108.1	107.9	112.7	111.9	− .7	1.5	[2]1.2
Finance and accounting	108.5	108.3	112.0	115.5	120.8	120.3	− .4	2.5	4.6
General support services	91.8	84.0	88.1	89.0	83.9	90.9	8.2	−.1	3.8
Information services	111.3	117.3	118.6	122.1	119.8	126.6	5.7	2.1	1.4
Legal and judicial activities	101.1	103.9	104.2	104.4	103.8	102.8	−1.0	.2	.3
Library services	110.6	112.8	122.1	120.0	125.2	129.0	3.0	3.1	4.3
Loans and grants	107.1	116.9	117.1	107.7	100.9	95.0	−5.8	−3.2	2.5
Medical services	101.5	101.6	103.5	104.1	107.0	105.5	−1.4	1.0	.4
Military base services	90.9	91.8	98.7	100.8	97.8	100.0	2.2	2.0	.5
Natural resources and environmental management	103.3	106.6	107.6	112.3	113.0	109.2	−3.3	1.4	1.5
Personnel investigations	97.8	101.0	94.4	102.3	109.3	101.5	−7.1	1.4	2.3
Personnel management	95.4	93.8	94.3	92.2	93.3	93.8	.5	− .4	.8
Postal service	101.7	102.0	103.6	103.7	103.6	103.4	− .1	.4	1.2
Printing and duplication	113.8	115.4	118.2	119.9	125.1	122.8	−1.8	1.8	.8
Procurement	101.5	97.8	95.4	96.9	93.5	87.9	−5.9	−2.4	2.2
Records management	104.3	101.1	107.0	104.4	99.6	98.6	−1.0	−1.0	2.9
Regulation—compliance and enforcement	107.0	109.8	118.6	115.3	109.1	106.6	−2.3	−.2	2.5
Regulation—rulemaking and licensing	111.1	116.9	114.8	117.8	117.7	116.3	−1.2	.8	3.5
Social services and benefits	107.5	115.7	111.9	117.5	121.6	125.8	3.5	2.8	2.3
Specialized manufacturing	107.8	110.1	111.8	109.6	118.0	119.4	1.2	2.0	3.3
Supply and inventory control	94.4	91.1	93.3	98.2	101.5	99.9	−1.5	1.9	1.3
Traffic management	96.4	103.3	95.6	111.8	128.1	122.0	−4.8	5.8	[3]2.4
Transportation	99.0	100.0	101.8	100.6	102.4	102.0	− .4	.6	2.1

[1] Fiscal year 1973–89.
[2] Fiscal year 1968–89.
[3] Fiscal year 1972–89.

NOTE: Average annual percent change based on the linear least squares trend of the logarithms of the index numbers.

Short-term trends. Although the rates of productivity change varied widely among the industries during the 1984–89 period, over 50 percent of the industries recorded higher productivity growth in the more recent period than in the period before 1984. However, of the industries that exhibited higher productivity growth during the later period, nearly one-fifth experienced declines in both output and employee hours.

Among the industries that posted an increase in the rate of productivity expansion during the 1984–89 period, several were notable. The primary copper, lead, and zinc industry recorded a dramatic improvement in its rate of growth—13.4 percent a year from 1984 to 1989 as opposed to 2.6 percent annually from 1947 to 1984. During the 1980's, pollution restrictions hit producers hard and many smelting operations were curtailed. Additionally, several copper, lead, and zinc smelters were closed in the mid-1980's because of a drop in prices. As a result, manufacturers have been operating at a higher and more efficient level of capacity than that during the post-1984 period. Likewise, the iron mining industry (usable ore) experienced markedly improved productivity performance during the 1984–89 period—9.9 percent per year versus 2.7 percent during the earlier period. In the mid-1980's the industry undertook a major restructuring and modernization effort aimed at lowering the cost of producing pelletized iron ore.

Several industries did, however, exhibit slowdowns in productivity growth in the post-1984 period. Among these was the labor-intensive fabricated pipe and fittings industry. From 1958 to 1984, the industry recorded no annual growth, in productivity, and in the post-1984 period, it actually showed an annual decline of 7.5 percent. High import levels have held back output growth, while plant closings have resulted in large scale employment losses.

The air transportation industry also exhibited a marked falloff in productivity during the 1984–

89 period. Before 1984, the annual rate of advance was 6.4 percent, but it declined to 0.9 percent in the later period. From 1947 to 1984, aircraft size increased by around 3 to 6 percent annually, but by 1984, the rate of growth in aircraft size peaked and, thereafter, began to decline.

New labor productivity measures

Two important industries, steel and autos, recorded productivity declines.

Frozen fruits and vegetables. Output per employee hour in the frozen fruits and vegetables industry increased at an average annual rate of 1.9 percent from 1972 to 1988. Output rose at an annual rate of 2.3 percent and employee hours increased 0.4 percent during this period. Demand for frozen fruits and vegetables rose as consumer preference for canned products declined.

Modernization in the industry increased during the period of this study and in some cases, led to shutdowns of marginal and inefficient plants that could not be economically renovated. Manufacturers adopted computer controlled production processes, such as automation in packing, packaging, and handling along with the widespread introduction of cooling extruders, automated metering pumps, and computerized package sealing systems.

Rubber and plastic hose and belting. Output per employee hour in this industry rose at an average annual rate of 1.2 percent from 1972 to 1988. This trend was well below the rate for all manufacturing which grew 2.8 percent per year during the same period. The growth in industry productivity reflected an average decline in output of 1.1 percent per year and a larger decline in employee hours of 2.3 percent per year.

The three major product groups in the industry are flat belts, v-belts or transmission belts, and hose. Flat belts are primarily purchased by mining and industrial conveyor users. The level of production in the motor vehicle industry is one of the major determinants of the level of production of v-belts. Output of hose depends largely on demand from motor vehicle manufacturers and specialty needs such as firehose and garden hose.

There was a modest growth in demand for rubber and plastic hose and belting over the 1972–88 period, but it was offset by rising imports of these products, which led to an overall decline in output. During the early 1970's, imports accounted for 3 to 4 percent of apparent consumption (shipments minus exports plus imports). By the mid-1980's, imports accounted for 9 to 13 percent of apparent consumption. Contributing to this growth in import penetration was the increase in industry unit-labor costs as rising wages were only partially offset by productivity advances. Moreover, from 1972 to 1988, domestic prices increased an average of 6 percent.

In general, productivity has been enhanced in the industry by gradual improvements in the various stages of production. New rubber compounds and mixing operations have made production more efficient and of higher quality. In the forming, or building of products, increased computerization in materials layout and process monitoring has boosted output per hour. Additionally, in the heat treating or vulcanizing process, manufacturers have attempted to boost productivity by using the fastest baking system that can be tolerated without scorching the product.

In the early years of the study period, major manufacturers mass-produced a wide variety of products in large plants. To tighten control of production and achieve the benefits associated with specialization, huge plants were reorganized and manufacturing focused on particular products. In some newly constructed plants, only one product was produced. In older plants, spaces were reorganized so that one huge plant became a collection of smaller factories producing only one product under its own management.

Industry multifactor productivity

In multifactor productivity measures, output is related to combined inputs of labor, capital, and intermediate purchases (materials, fuels, electricity, and services). Multifactor productivity is equal to output per hour adjusted to remove the effects of changes in capital per hour and intermediate purchases per hour.

Multifactor measures are available for the tires and tubes, footwear, steel, farm and garden machinery, and motor vehicle industries and have been updated through 1988. Data for multifactor productivity and related indexes for 1984–88 are presented in table 2.

Current developments. Multifactor productivity rose during 1988 in all five industries: tires and inner tubes (1.4 percent), footwear (0.9 percent), steel (9.0 percent), farm and garden machinery (5.4 percent), and motor vehicles and equipment (4.0 percent). Substantial output gains in steel (21.6 percent) and in farm and garden machinery (16.5 percent) spurred the large multifactor productivity increases. Output in motor vehicles (4.6 percent) and in tires and tubes (5.2 percent) experienced more modest gains, while footwear output continued its long-term decline, falling 0.6 percent in 1988.

The 21.6-percent increase in steel output,

which brought the level of steel production back up to the level before the severe contraction in 1982, substantially outpaced the 11.6-percent rise in combined inputs. The output gain was matched by a similar 21.8-percent jump in intermediate purchases, but labor input rose only 4.2 percent and capital input actually declined 4.2 percent. In farm and garden machinery, the strong 16.5-percent output gain significantly exceeded the 10.5-percent rise in combined inputs. The increase in intermediate purchases (17.1 percent) was close to that of output, but labor input grew somewhat less (11.5 percent) and capital input showed no change.

Underlying the 4.0-percent gain in multifactor productivity in motor vehicles and equipment was a 4.6-percent increase in output and a 0.6-percent rise in combined inputs. Labor input (1.5 percent) and intermediate purchases (0.8 percent) edged up slightly, while capital input dropped 1.3 percent. In the tires and tubes industry, increases of 5.2 percent in output and 3.8 percent in combined inputs yielded the 1.4-percent multifactor productivity gain. Capital input declined by 2.0 percent in this industry, while labor input rose 6.3 percent and intermediate purchases increased 4.7 percent.

In the footwear industry, multifactor productivity gained 0.9 percent, reflecting a 0.6-percent drop in output and a 1.5-percent decline in combined inputs. The fall in output was the 12th consecutive annual decline, although it was the smallest drop since 1978. Decreases occurred in all inputs in 1988, with capital falling 2.9 percent, labor hours 1.8 percent, and intermediate purchases 0.8 percent.

During the 1984–88 period, substantial average annual gains in multifactor productivity were recorded in the tires and inner tubes (3.1 percent) and steel (6.3 percent) industries. In tires and tubes, the elimination of older, less efficient plants yielded productivity gains. A strong output increase in 1987 led to a substantial rise in multifactor productivity in that year. The closing of older plants has also been a spur to productivity advances in steel, as has the shift toward continuous casting of finished products, which increased from 40 percent to 60 percent of total steel production from 1984 to 1988.

In the farm and garden machinery industry, multifactor productivity grew an average 1.7 percent per year from 1984 to 1988. Output continued its steep, almost uninterrupted, slide from its 1979 peak, falling 14.0 percent in 1985 and 10.3 percent in 1986. These drops were accompanied by multifactor productivity declines of 4.3 percent in 1985 and 2.5 percent in 1986. In the latter 2 years of the period—1987 and 1988—the output slump was ended with jumps of 11.5 percent in 1987 and 16.5 percent in 1988. These increases led to multifactor productivity gains of 8.1 percent and 5.4 percent.

In the motor vehicles and equipment industry, multifactor productivity showed a significant gain of 4.0 percent in both 1985 and 1988. However, a decline of 4.9 percent was recorded in 1986, a year of declining output, which dampened the average growth rate of multifactor productivity for the 1984–88 period to 0.3 percent. In the footwear industry, multifactor productivity showed an average annual drop of 0.5 percent for the 1984–88 period. Output fell sharply in 1985 (13.5 percent) and 1986 (11.4 percent) as strong increases in the demand for imported shoes stiffened competition, leading to declines in multifactor productivity of 6.4 in 1985 and 0.5 percent in 1986. The decline in output, combined with slow rates of introduction and diffusion of technological innovations, has made it very difficult to attain productivity gains in this industry.

New multifactor measures

Farm and garden machinery. Multifactor productivity in the farm and garden machinery industry increased 0.1 percent per year on average for the 1958–88 period. This resulted from average annual gains of 0.7 percent in output and 0.6 percent in combined inputs. Labor productivity grew at a 1.4-percent average annual rate over this period. The difference between labor productivity and multifactor productivity was the result of the effects of increases in capital per hour of 0.6 percent and intermediate purchases per hour of 0.7 percent.

Labor productivity rose at a fairly strong pace of 2.4 percent between 1958 and 1973, but fell off sharply in the 1973–88 period to show a decline of 0.3 percent. The post-1973 slowdown in productivity was typical of many manufacturing industries, but, while a reversal of the slowdown was clear in manufacturing in the 1980's, farm and garden machinery continued to show declines in most years until 1986. This prolonged slowdown was strongly influenced by sharp declines in output from 1979 to 1986, averaging 10.5 percent. The steep decline in output was attributed to several factors depressing demand for U.S.-built farm machinery. Such factors included soaring interest rates in the late 1970's and early 1980's; falling commodity prices in that period; agricultural policies that attempted to reduce land under cultivation; a surplus of used farm and garden equipment generated by farmers being forced out of business during this period; and a substantial jump in the penetration of imported machinery into the U.S.

Among the industries with the highest growth in labor productivity were semiconductors and wet corn milling.

market. In 1987 and 1988, output rebounded with double-digit increases, yielding strong gains in both labor productivity and multifactor productivity.

Government productivity

Productivity for functions within the Federal Government, as measured by output per employee year, are updated to 1989 in table 3. Indexes are presented for fiscal years 1984–89, and average annual rates of change are shown for 1984–89 and 1967–89. In addition, State and local government productivity is presented for the years 1984–89 for electric power services, sales of alcoholic beverages, and unemployment insurance activity.

Federal, 1989. Productivity decreased 0.3 percent in fiscal 1989 in the measured portion of the Federal Government. This decline reflected a decrease of 0.1 percent in output, the first year output has declined, and an increase of 0.3 percent in employee years. This is the second productivity decline in 22 years; the only other decline occurred in 1974 when productivity decreased 0.5 percent.

The overall productivity measure includes 2.1 million executive branch civilian employees, representing 68 percent of the total Federal civilian labor force. Federal organizations are divided into 28 functional categories based on similarity of tasks performed, for example, auditing, medical, and transportation. Productivity increased in 10 functions and decreased in 18.

The electric power production and distribution function, which includes those organizations responsible for generating, transmitting, or selling electricity, showed a significant 37.5-percent increase in productivity in 1989. By contrast, the personnel investigations function, which includes organizations responsible for conducting personnel security checks or criminal investigations of Federal employees, showed a decline of 7.1 percent in 1989. The largest of the 28 functions in terms of number of employees includes only a single organization, the U.S. Postal Service. It experienced a productivity decline of 0.1 percent in 1989, as output increased 0.5 percent while labor increased 0.6 percent. In 1988, Postal Service productivity also experienced a 0.1-percent decline.

Trends, 1967–89. Over the 1967–89 period, productivity in the measured portion of the Federal Government rose at an average annual rate of 1.4 percent. The overall increase in Federal Government productivity reflected an average rise of 1.6 percent in output and an increase of 0.2 percent in labor input. Shifts in program emphasis and delivery of government services over the long term are reflected in both output and employee-year trends.

Among the 28 functions, communications had the largest average annual increase in productivity over the long term (9.5 for 1973–89). Between 1973 and 1982, productivity in communications increased at an average annual rate of 11.8 percent. The exceptional, long-term productivity increases were attributed primarily to technological improvements in equipment that receives and transmits messages instantaneously all over the world.

At 4.6 percent, the function having the second largest long-term average annual increase in productivity was finance and accounting. This function includes internal government operations such as payroll and voucher operations, and final government services, such as Treasury bill and bond sales to the public. Finance and accounting productivity has improved in 17 of the 22 years measured, the result of automation of many of the routine processing operations. In one organization that serves the public, productivity doubled in 1 year as output mushroomed, operations were mechanized, and employment was held fairly constant.

On the downside, electric power production and distribution registered the only long-term decrease in productivity of the 28 functions, 3.8 percent for 1967–89. Productivity has decreased in 14 of the last 22 years, reflecting a decrease in output, particularly in recent years. Although employment in electric power production and distribution has been cut back during the last 7 of 9 years, the decreases in output exceeded the cuts in input by a wide margin. The decrease in employee years is primarily a result of cutbacks in the nuclear power production area.

State and local government services. Output per employee year in State and local government electric power services increased 1.7 percent in 1989 as output increased 2.1 percent and input increased 0.4 percent. The long-term productivity trend (1967–89) shows an average annual increase of 1.6 percent, with output increasing at a rate of 3.4 percent and employment increasing at 1.8 percent.

Productivity in State sales of alcoholic beverages increased 1.9 percent in 1989 as output decreased 2.7 percent and input dropped 4.5 percent. In 1988, productivity, output, and input declined. The drop in output in 1988 and 1989 was a continuation of a trend that started in 1980. This trend reflects decreasing demand for spirits and a shift in several States from government to private sector operations.

Productivity in State unemployment insurance activities decreased 1.0 percent in fiscal 1989 as output increased 3.1 percent and labor input increased 4.1 percent. This was the first increase in output in 4 years and the first increase in labor input in 6 years. During 1984–89, productivity remained unchanged while output and labor each decreased at an average annual rate of 3.4 percent. Over the 1964–89 period, productivity increased at an average annual rate of 0.7 percent, with output increasing at an average annual rate of 2.9 percent and labor increasing at 2.2 percent.

Additional research

Productivity measures for industry and State and local government, published by the Office of Productivity and Technology, are for the most part constructed from secondary source data. Consequently, the preparation of industry measures is largely limited to those industries for which data are readily available. However, more industry and government productivity measures will be developed in the future. Extensions and analysis of previously published industry and government services are ongoing.

Footnotes

[1] A full report, *Productivity Measures for Selected Industries and Government Services*, Bulletin 2349 (Bureau of Labor Statistics, 1990), is available ($10) from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402, or from the Bureau of Labor Statistics, Publications Sales Center, P.O. Box 2145, Chicago, IL 60690. A more recent version of this publication, Bulletin 2378, which includes data through 1989 and a list of recent BLS publications on productivity and technology, is forthcoming. For a discussion of concepts, methods, and sources, see "Productivity Measures: Industries and Government," reprint of chapter 11 of the *BLS Handbook of Methods*, Bulletin 2285 (Bureau of Labor Statistics, 1988). See also, *Productivity: A Selected Annotated Bibliography, 1983–87*, Bulletin 2360 (Bureau of Labor Statistics, 1990).

[2] See John W. Ferris and Virginia L. Klarquist, "Productivity in the rubber and plastics hose and belting industry," *Monthly Labor Review*, July 1990, pp. 26–31. See also, Edna Falk and Diane Litz, forthcoming *Monthly Labor Review* article on multifactor productivity in the farm and garden equipment industry.